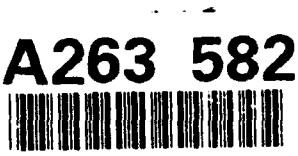

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ONR ANNUAL PROGRESS REPORT 1992

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Dynamics of Small-Scale Oceanic Motions ONR N00014-90-J-1419

Research Goals:

Description and modeling of the kinematical structure and dynamical processes of oceanic motions that have horizontal scales from a few meters to a few kilometers. Understanding the role that these small-scale motions play in the redistribution and mixing of momentum, potential vorticity, heat, and salt. Contribute to the construciton of a global numerical model that will predict this redistribution and mixing.

Objectives:

Identify the processes that affect the kinematical and dynamical evolution of near-inertial internal gravity waves, especially those processes that can transfer energy out of near-inertial internal waves into the internal wave continuum. Simulate these processes in a numerical model. Assess the feasibility of monitoring the upper ocean internal wave field from routinely taken measurements with ship *mounted Acoustic Doppler Current Profilers.* Assess the feasibility of using such observations for verification and calibration of numerical models.

Approach:
Blend of data analysis, theory and numerical modeling.

Tasks Completed:

Derivation of model equations that filter out high frequency internal waves, low frequency (geostrophic) currents and barotropic motions and describe efficiently the kinematical and dynamical evolution of near-inertial internal gravity waves. Initial theoretical analysis and numerical implementation of these equations. Preparation of current measurements taken by a ship mounted Acoustic Doppler Current Profiler in the wake of hurricane Ofa for model-data comparison.

Scientific Results:

Fluctuations in the atmospheric windstress excite inertial oscillations in the surface mixed layer and a fraction of the energy from these oscillations penetrates the ocean interior as near-inertial internal waves. The further kinematic and dynamic evolution of these near-inertial internal waves is not well understood. These waves do not propagate well. (Their horizontal and vertical group velocity approaches zero as their frequencies approach the Coriolis frequency). These waves also do not interact well. (Resonant interactions among near-inertial internal waves are impossible). To investigate the effects that determine the evolution of near-inertial internal waves, model equations can be derived that filter out the effect of high frequency internal waves, low frequency (geostrophic) currents and barotropic motions, but retain the effects of windstress forcing, nonlinear self-interaction, lateral variations of ocean depth, buoyancy frequency and Coriolis frequency, the meridional component of the earth's rotation, and the interaction with a prescribed mean flow. These equations are well suited for theoretical investigations and numerical simulation.

Accomplishments:

Derivation of filtered model equations for near-inertial internal waves that allow focused theoretical investigations and efficient numerical simulation.

ONR-Sponsored Publications

P- Lien, R.-C., and P. Muller, 1992: Consistency relations of gravity and vortical modes in the ocean. Deep Sea Res., 39, 1595-1612.

PS- Schneider, N., and P.Muller, 1992: On the sensitivity of the surface equatorial ocean to the parameterization of vertical mixing. J. Phys. Oceanogr.

PS- Muller, P., 1992: Diapycnal Mixing in the Ocean: a review. In: " Large Eddy Simulation of Complex Engineering and Geophysical Flows, Cambridge University Press." (in press)

PS- Lien, R.-C., and P. Muller, 1991: Normal mode decomposition of small-scale oceanic motions. J. Phys. Oceanogr. (in press)

PI- Kunze, E., and P. Muller, 1991: Internal wave-driven

Ekman flow in the ocean interior.

PI- Garwood, R.W., Jr., P.C. Chu, P. Muller and N. Schneider, 1991: Modeling the equatorial entrainment zone: Response to diurnal surface forcing.

PI- Lien, R.-C., E. Firing and P. Muller, 1992: Observations of strong inertial oscillations after the passage of typhoon Ofa.

PI- Muller, P., 1991: Ertel's potential vorticity theorum revisited.

R- Lien, R.-C., and P. Muller, 1991: Estimates of small-scale horizontal divergence and relative vorticity in the ocean. In: "Dynamics of Oceanic Internal Gravity Waves. Proceedings, 'Aha Huliko'a Hawaiian Winter Workshop, School of Ocean and Earth Science and Technology, Special Publication." 143-156.

Statistics
1 Papers published, refereed journals
3 Papers submitted, refereed journals
0 Books or chapters published, refereed publication
0 Books or chapters submitted, refereed publication
0 Invited presentations
0 Contributed presentations
1 Technical reports and papers, non-refereed journals
0 Undergraduate students supported
2 Graduate students supported
0 Post-docs supported
1 Other professional personnel supported

EEO/Minority Support
0 Female grad students
0 Minority grad students
0 Asian grad students
0 Female post-docs
0 Minority post-docs
0 Asian post-docs

Patents and awards

Influences:

D'Asaro E.A., 1989: The decay of wind-forced mixed layer inertial oscillations due to the Beta effect. J. Geophys. Res., 94, 2045-2056.

Hasselmann, K., 1970: Wave-driven inertial oscillations. Geophys. Fluid Dyn., 1, 463-502.

Kunze, E., 1985: Near inertial wave propagation in geostrophic shear. J. Phys. Oceanogr., 15, 544-565.

Watson, K.M., 1990: The coupling of surface and internal gravity waves. J. Phys. Oceanogr., 20, 1233-1248.